UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P O Box 1450
Alexandria, Virginia 22313-1450
www uspto gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 10/501,145 | 07/13/2004 | Lieven Anaf | 016782-0310 | 5358 |

22428 7590 10/01/2008
FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

| EXAMINER | |
|---|---|
| SCULLY, STEVEN M | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 1795 | |

| MAIL DATE | DELIVERY MODE |
|---|---|
| 10/01/2008 | PAPER |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/501,145 | ANAF ET AL. | |
| | **Examiner** | **Art Unit** | |
| | Steven Scully | 1795 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *18 June 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-17,19 and 20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-17, 19 and 20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

**POROUS METAL STACK FOR FUEL CELLS OR ELECTROLYSERS**

Examiner: Scully S.N.: 10/501,145 Art Unit: 1795 September 20, 2008

## DETAILED ACTION

1. The Amendment filed June 18, 2008 has been entered. Claims 1-17 remain pending in the application. Claim 18 has been canceled and new claims 19 and 20 have been added.

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

### *Claim Rejections - 35 USC § 112*

3. The previous rejections of claims 1-17 under 35 U.S.C. 112, second paragraph, have been withdrawn in light of Applicant's amendment to the claims.

### *Claim Rejections - 35 USC § 103*

4. Claims 1-6 and 9-17 remain rejected under 35 U.S.C. 103(a) as being unpatentable over Cisar et al. (US6,562,507).

With respect to claim 1, Cisar et al. disclose a stack comprising an impermeable metal structure (see claim 1, column 10, lines 44 to 45), one first metal fiber layer and one second metal fiber layer made of sintered metal fibers (see claim 2, column 10, lines 56 to 59), said impermeable metal structure being sintered to one side of said first

metal fiber layer (see claim 1, column 10, lines 46 to 47), said second metal fiber layer being sintered to the other side of said first metal fiber layer (see claim 7).

Cisar et al. are silent with respect to the planar air permeability of said stack being more than 0.02 l/min*cm, and the porosity of said second metal fiber layer being less than 80%.

However, Cisar et al. disclose that testing was performed on the foam flow field for flow resistance involved observed pressure drop for constant flow, at various gas flow rates and total pressures, with air (see column 8, lines 23 to 28). Cisar et al. further disclose that the gas flow field can be made of sintered metal fibers (see claim 2, column 10, lines 56 to 59). These gas flow measurements help to determine the variation in permeability and porosity of the flow field. Cisar et al. disclose by using sintered metal spheres you can control the size distribution of the spheres with sintering conditions, time and temperature and the porosity can be accurately controlled (see column 8, lines 39 to 45). Further, Cisar et al. disclose that first and second metal fiber layers can be made of micro and macro particle sintered porous metals (see column 8, lines 46 to 48). It would have been obvious to one of ordinary skill in the art at the time of the invention to vary the planar air permeability and porosity of the flow fields, including those made of sintered metal fibers as disclosed in claim 2 of Cisar et al., to adjust the reactants going to the plate for the benefit of improving the electric contact areas of the cell.

Cisar et al. disclose that the flow field can be used with various air flow rates, thus recognizing that the air permeability is a result effective variable of the flow field

plates. It has been held by the courts that discovering the optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F. 2d 272, 205 USPQ 215 (CCPA 1980). See MPEP 2144.05. Cisar et al. disclose "by controlling the size distribution of the spheres and the sintering conditions, time and temperature, the porosity of the finished part can be accurately, and reproducibly, controlled," (see column 8, lines 41 to 44), thus recognizing that the porosity is a result effective variable of the metal fiber layer. It has been held by the courts that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F. 2d 272, 205 USPQ 215 (CCPA 1980). See MPEP 2144.05.

With respect to claim 2, Cisar et al. disclose a stack as in claim 1, said stack comprising another first metal fiber layer sintered to a second side of said impermeable metal structure and another second metal fiber layer sintered to the another first metal fiber layer on a side opposite to the impermeable metal structure (see column 9, lines 48 to 52; Figure 15).

With respect to claim 3, Cisar et al. disclose a stack with said first metal fiber layers having a porosity of more than 80%. Cisar et al. disclose nickel foam having a nominal density of 5% that of the solid metal and a nominal pore spacing of 80 pores per linear inch (see column 8, lines 14 to 16). Cisar et al. disclose the flow fields for PEM fuel cell stacks have also been made successfully using low density nickel foam (see column 8, lines 8 to 10). Further, Cisar et al. recognize that porosity of the flow field is a result effective variable, as discussed above with regard to claim 1. It would have been obvious to one of ordinary skill in the art at the time of the invention to

provide the sintered metal fibers of Cisar et al. with a high porosity because Cisar et al. teach reactant flow rate to the plate can be adjusted to improve cell performance.

With respect to claim 4, Cisar et al. are silent regarding said second metal fiber layers having a perpendicular air permeability of less than 200 l/min*dm2. Cisar et al. disclose that testing was performed on the flow field for flow resistance which involved observed pressure drops for constant flow, at various gas flow rates and total pressures, with air (see column 8, lines 23 to 38). These gas flow measurements help to determine the variation in permeability and porosity of the flow field.

It would have been obvious to one of ordinary skill in the art at the time of the invention to vary the planar air permeability and porosity to adjust the reactants going to the plate for the benefit of improving the electric contact areas of the cell. Cisar et al. disclose that the flow field can be used with various air flow rates, thus recognizing that the air permeability is a result effective variable of the flow plates. It has been held by the courts that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F. 2d 272, 205 USPQ 215 (CCPA 1980). See MPEP 2144.05.

With respect to claims 5 and 6, Cisar et al. are silent with respect to said first metal fiber layers comprising fibers with equivalent diameter of more than 20 um and the second metal fiber layer comprising fibers with equivalent diameter of less than 30um. Cisar et al. disclose using micro and macro particle sintered porous metals to form the electrode substrates and current collectors (see column 8, lines 46 to 48). Cisar et al. disclose by using sintered metal spheres until they bond into a solid

monolithic mass to produce a porous metal component and by controlling the conditions of the size distribution of the spheres, and the sintering conditions, time and temperature, the porosity of the finished part can be accurately and reproducibly controlled (see column 8, lines 39 to 45).

Cisar et al. disclose that by using sintering metal spheres to form a porous metal component can also determine the desired diameter of the metal fiber layer as a result effective variable. It would have been obvious to vary the equivalent diameter of the metal fiber layer for the benefit of varying the porosity of the metal fiber layers. It has been held by the courts that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F. 2d 272, 205 USPQ 215 (CCPA 1980). See MPEP 2144.05.

With respect to claim 9, Cisar et al. are silent with regard to said stack having a transversal electric resistance less than 30*10-3 Ohm. Cisar et al. disclose that the component or subassembly provides a metal structure having higher electrical conductivity than conventional bipolar plates or stack structures (see column 6, lines 18 to 20). It would have been obvious to one of ordinary skill in the art at the time of the invention to reduce the electric resistance in order to achieve higher electrical conductivity in the metal structure. Higher electrical conductivity in the invention can reduce the number of parts in the unit and thus making it lighter in weight.

With respect to claim 10, Cisar et al. disclose a stack as in claim 1, said impermeable metal structure being a fluid cooled plate (see claim 14).

With respect to claim 11, Cisar et al. disclose a stack as in claim 1, said impermeable metal structure being a metal foil gas barrier (see claim 1).

With respect to claim 12, Cisar et al. disclose a stack as in claim 1, said metal fibers being stainless steel fibers (see claim 3).

With respect to claim 13, Cisar et al. disclose a stack as in claim 1, said metal fibers being Ni-fibers or Ni alloy fibers (see claim 3).

With respect to claim 14, Cisar et al. disclose a stack as in claim 1, said metal fibers being Ti-fibers (see claim 3).

With respect to claim 15, Cisar et al. disclose a stack as in claim 1, said metal fibers having the same alloy of said impermeable metal structure by combining all three structures into a single unitary metallic part which includes gas distribution structure, the gas diffusion structure, and the gas barrier structure (see abstract, lines 8 to 11).

With respect to claim 16, Cisar et al. disclose wherein the electrochemical cells are fuel cells, comprising stacks as in claim 1 (see claim 26).

With respect to claim 17, Cisar et al. disclose wherein the electrochemical cells are electrolyser cells, comprising stacks as in claim 1 (see claim 27).

5. Claims 7 and 8 remain rejected under 35 U.S.C. 103(a) as being unpatentable over Cisar et al. (US6,562,507) as applied to claims 1-6 and 9-17 above, and further in view of Ramunni et al. (US6,022,634).

With respect to claims 7 and 8, Cisar et al. disclose a stack as in claim 1, said first metal fiber layers having a thickness of 1.1mm (column 8, lines 45 to 49) but does

not disclose no more than 0.5mm or less than 0.2mm and said second metal fiber layers having a thickness of 1.1mm (column 8, lines 45 to 49) but does not disclose no more than 0.5mm or less than 0.2mm. Ramunni et al. teach metal fiber layer thickness of between 0.1 and 0.3mm (see column 3, lines 46 to 48). Ramunni et al. teach metal fiber layer thickness of between 0.1 and 0.3mm (see column 3, lines 46 to 48). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the thickness of the metal fiber layer, because Ramunni et al. teach the optimum thickness for the gas to travel to the reaction site is between 0.1 to 0.3 mm..

6. Claims 19 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cisar et al. (US6,562,507) as applied to claims 1-6 and 9-17 above, and further in view of Rosenmayer (US6,605,381).

With respect to claims 19 and 20, Cisar et al. are silent with regard to the porosity of the first and second metal fiber layers with respect to one another. Rosenmayer discloses a polymer-electrolyte membrane fuel cell having an inner 4 and an outer layer 3 of a gas diffusion structure. The gas diffusion structure 3,4 consists of porous, electrically conductive materials and is an orthogonale structure that must be adapted with respect to their pore volumes in order to achieve a gradient in terms of gas permeability. The outer layer 3 has a relatively small pore volume and consequently a high diffusion resistance. The inner part 4 of the gas diffusion structure, however, has a relatively high pore volume. Therefore, the reaction gases get distributed sufficiently well by way of diffusion within the inner layer 4. See Column 3, lines 48-67. It would

have been obvious to one of ordinary skill in the art at the time of the invention to provide the first metal fiber layer of Cisar et al. with high pore volume and the second metal fiber layer of Cisar et al. with a low pore volume because Rosenmayer teaches the reaction gases get distributed sufficiently well by way of diffusion within the first metal fiber layer.

***Response to Arguments***

7. Applicant's arguments filed June 18, 2008 have been fully considered but they are not persuasive. Applicant argues:

*a) The flow field of Cisar et al. is not a first or second metal fiber layer because expanded metal and porous foam are not made of metal fibers.*

*b) The metal spheres of Cisar et al. are not metal fibers and thus do not form a basis that the porosity of a metal fiber layer is a result effective variable.*

*c) Nickel foam is not a metal fiber layer, therefore claim 3 would not have been obvious.*

With respect to argument a), applicant is directed to, for example, claim 2 of Cisar et al. wherein the flow fields are sintered metal fibers. While the specification focuses on a metal foam, sintered metal fibers are disclosed for use in the fuel cell of Cisar et al.

With respect to argument b), much the same as above, the result effective variables of the flow field are compatible whether it be a metal sphere or a metal fiber,

and one of ordinary skill in the art would still recognize them to be result effective variables because in each case the porosity and air permeability would be related to the efficacy of the fuel cell.

With respect to argument c), it is appreciated that the nickel foam is not composed of metal fibers. However, the fuel permeability to the electrodes is directly related to the porosity of the layers. The nickel foam is disclosed to have 95% open volume. In order for the metal fiber layer to allow the same fuel flow it would also require a high porosity.

### *Conclusion*

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

***Contact/Correspondence Information***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven Scully whose telephone number is (571)270-5267. The examiner can normally be reached on Monday to Friday 7:30am to 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dah-Wei Yuan can be reached on (571)272-1295. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/S. S./
Examiner, Art Unit 1795

/Dah-Wei D. Yuan/
Supervisory Patent Examiner, Art Unit 1795